Notes on the Biology of *Hypothyris euclea* in Costa Rica

(Lepidoptera: Nymphalidae: Ithomiinae)

Allen M. Young

Department of Invertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233

Although the local species density of ithomiine butterflies in tropical forests can be high (Brown, 1972), it is generally unusual to find very large adult populations of a single species. However, some ithomiines, such as *Hypothyris euclea euclea* (Latreille) in Trinidad, have seasonal bursts of synchronous eclosion (Barcant, 1970), which could lead to the sudden appearance of large numbers of adults over a short period of time at a locality. This paper reports the biology of *Hypothyris euclea leucania* (Bates) (tribe Napeogenini) at one locality in northeastern Costa Rica, and emphasizes that the larvae of this butterfly are gregarious defoliators of *Solanum rugosum* Dund. (Solanaceae) during the early dry season. The preliminary data on defoliation of this food plant suggests that heavily defoliated plants produce fewer flowers and fruits.

Habitat and Methods

Clumps of mature *S. rugosum* create a canopy of about three meters high in young secondary forest (2–10 years old) at "Finca La Tirimbina", near La Virgen (220 m elev.), Heredia Province, Costa Rica. The locality is in the Premontane Tropical Wet Forest life zone (Holdridge, 1967). Previous observations revealed that *S. rugosum* is the food plant of *H. euclea* at this locality; other food plants have not been found. Therefore, I began studies on the biology of *H. euclea* in the field and laboratory, using methods of previous studies (e.g., Young, 1974). Most observations were made between January 12 and February 12, 1976, and finally on March 31, 1976. Included in these studies was the estimation of defoliation by counting heavily fed upon) in four large clumps (Patches 1–4). I also counted the number of individuals in each clump bearing flowers or fruits (*Solanum rugosum* flowers and sets fruit during January and February, months of erratic dry spells which precede a period of more uniform dryness (March)). The four clumps of *S. rugosum* were visited a total of eleven days during the period of January 12 to February 12. As little is known about the life cycle of this species, oviposition and early stages were also observed.

Results

General Biology: Oviposition activity is high during January, and rafts of oblong white eggs are placed on the ventral sides of mature leaves throughout the day (Fig. 1). From January 12 to February 12,

The Pan-Pacific Entomologist 53:104-113. April 1977.

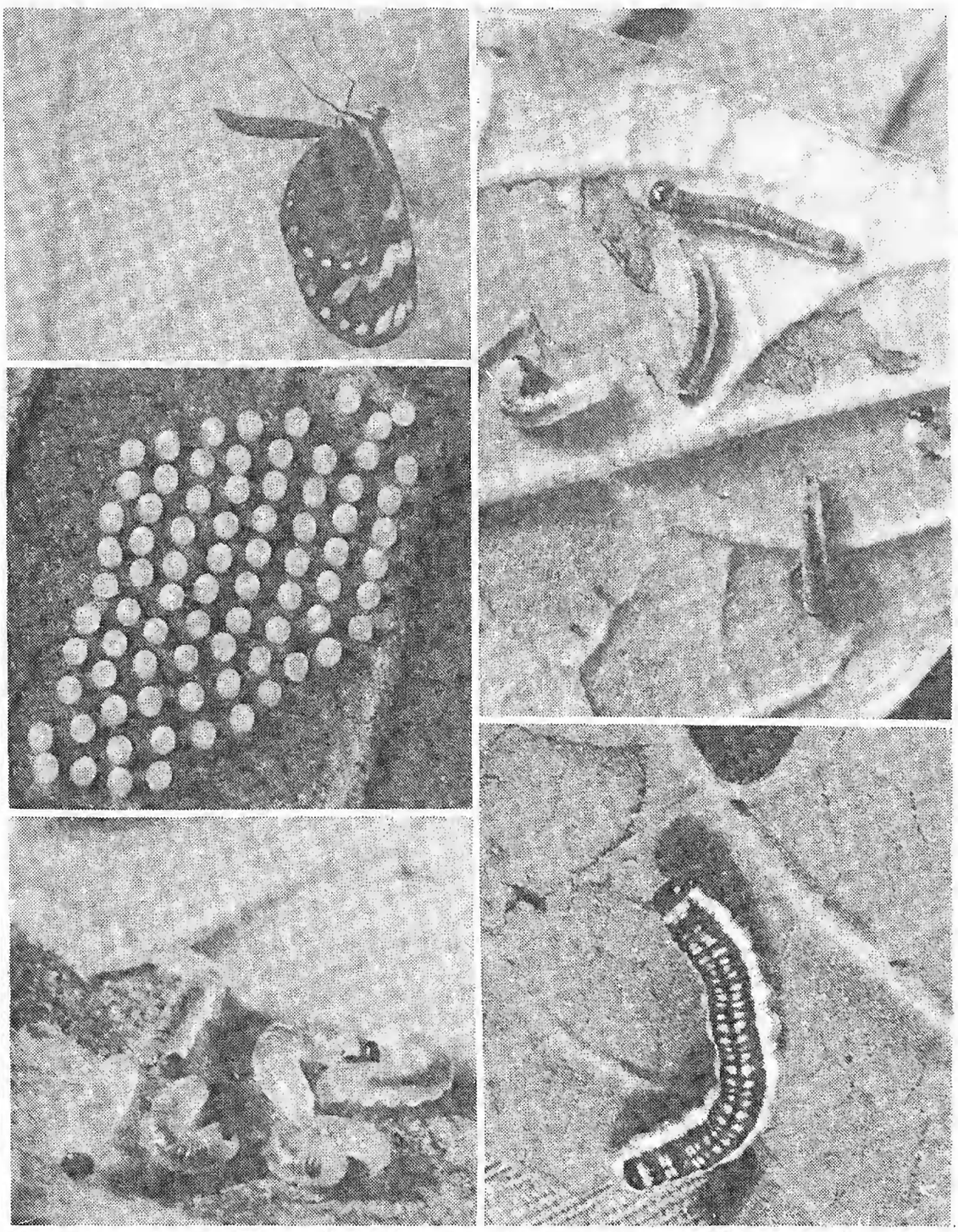

Fig. 1. Life cycle of *Hypothyris euclea leucania*. First column, top to bottom: female in oviposition, raft of eggs, first instar caterpillars. Second column: second instar caterpillars and a third instar caterpillar.

more than 50 oviposition acts were observed in Patch 2, and of about 5,000 eggs counted in different clumps at various times (4 days) during this period, 70% were found in Patch 2. A raft of eggs has from 40 to 90 eggs, and an egg is deposited at five-second intervals until a raft is completed. During January and February, 73 egg rafts were discovered in Patch 2. Oviposition by other ithomiines on this plant was not observed during the study period. Four to five days after eggs are

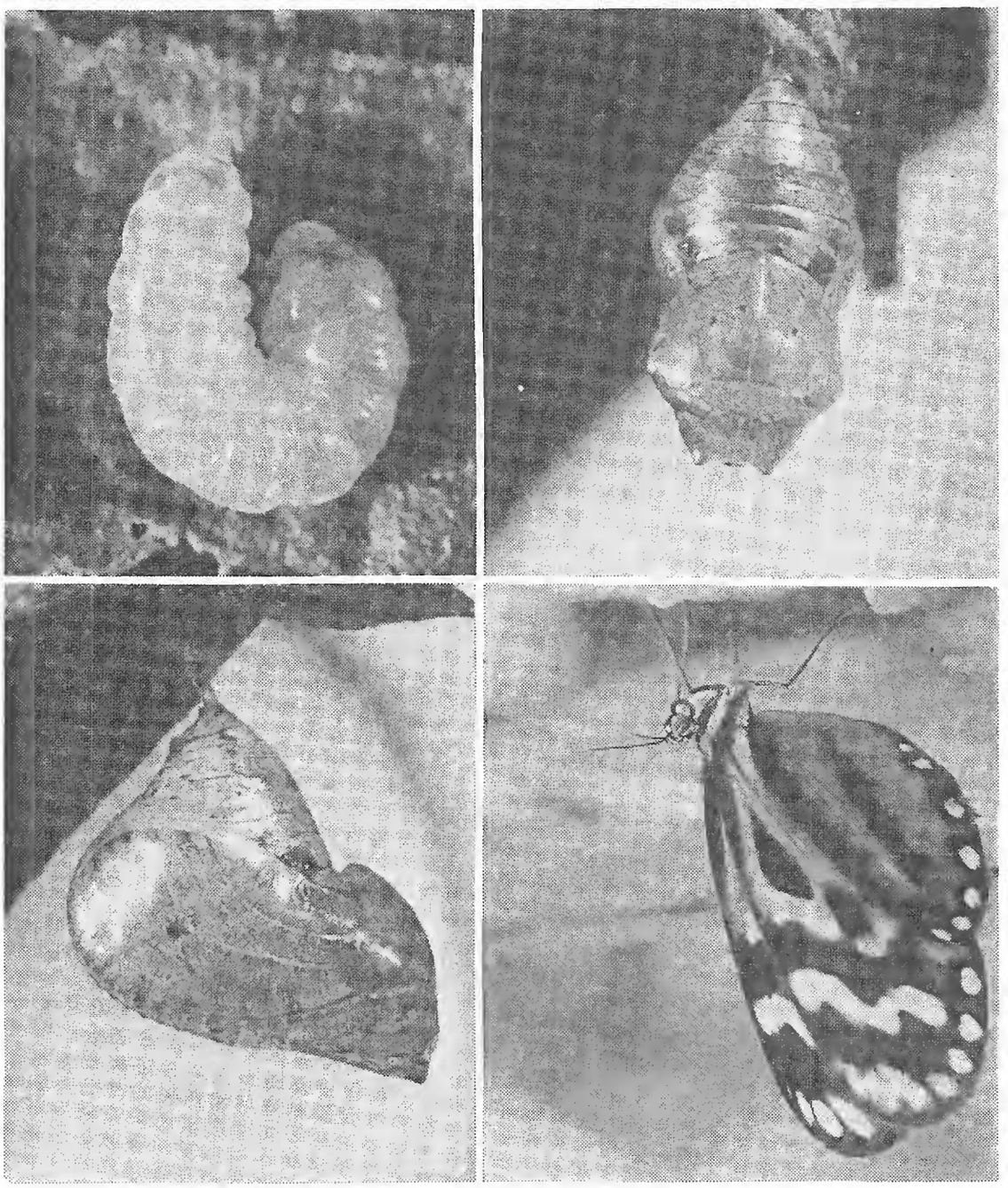

Fig. 2. Life cycle of *H. euclea*. Left: prepupa and lateral view of pupa; Right: dorsal view of pupa, and freshly-eclosed adult in the field.

laid, they produce greenish-yellow translucent larvae with shiny black heads; second instar larvae are dark green, and third instars possess a striped color pattern of light blue, dark gray, and yellow (Fig. 1). The latter color pattern also occurs in the fourth and fifth instars, and a translucent light green prepupa produces a golden pupa (Fig. 2). The adults appear about 22 days later, bearing the familiar orange, yellow, and black "tiger stripe" pattern characteristic of some species in the tribe Napeogenini (Fig. 2). Adults produced from a single cluster of

eggs may exhibit some color variation within sex (Fig. 3). In northeastern Costa Rica, as in eastern Brazil (Brown and D'Almeida, 1970), *Hypothyris* is sympatric with several other ithomiine genera at forest edge habitats.

Adults are slow fliers of shady forest edge and light gap habitats, where they feed on a variety of resources, including the partly eaten remains of insects, presumably attacked by birds and other small vertebrates (Fig. 3).

A distinctive behavioral feature of the larvae is their gregarious habit. Young larvae, recently hatched from an egg raft, stay together on a leaf, but as they grow, they split up into smaller groups on different mature leaves. Survival from predators and parasites seems high, although short periods of heavy rain often result in large numbers of larvae dying.

Gregarious Defoliation: The cluster oviposition habit of *H. euclea,* in which the number of eggs per raft is much higher than for *Mechanitis* (another ithomiine with gregarious larvae), results in the gregarious larvae becoming severe defoliators (Fig. 4 and 5). The defoliation often results in a "skeleton canopy" (Fig. 6).

Food plant clumps with little or no defoliation bear large numbers of flowers and fruits. In fact, in unattacked shrubs, 30 to 60 clusters of healthy fruit occur on each shrub: of a total of 23 shrubs examined, the mean number (and standard deviation) of fruit clusters is 41 $\pm$ 19.5, and the mean number of fruits per cluster is 32 $\pm$ 11.2. Inflorescences are abundant during late January, and green fruits are abundant by February. Thus, the infestation of *H. euclea* is intense (January and perhaps earlier) when the *S. rugosum* population is entering a period of reproduction. In the four widely separated clumps studied, although canopy height and branch density are very similar, clumps of shrubs not heavily defoliated have far more flowers or fruits than individuals in clumps of severe defoliation by *H. euclea* larvae (Table 1). Although the sample size is small, the four clumps examined are sites where this species is very abundant. While leaf damage is severe in these clumps, by March 31 the *H. euclea* population had either experienced a severe reduction in size or else dispersed, as very few adults, eggs, and caterpillars were present, and previously attacked shrubs had fresh leaves. During January and February there are probably only two or three overlapping generations present on *S. rugosum.*

Discussion

Although it is reported that *Mechanitis* is the only ithomiine genus exhibiting gregarious behavior of the immature stages (Rathcke and Poole, 1975), it is apparent that *Hypothyris* also possesses this be-

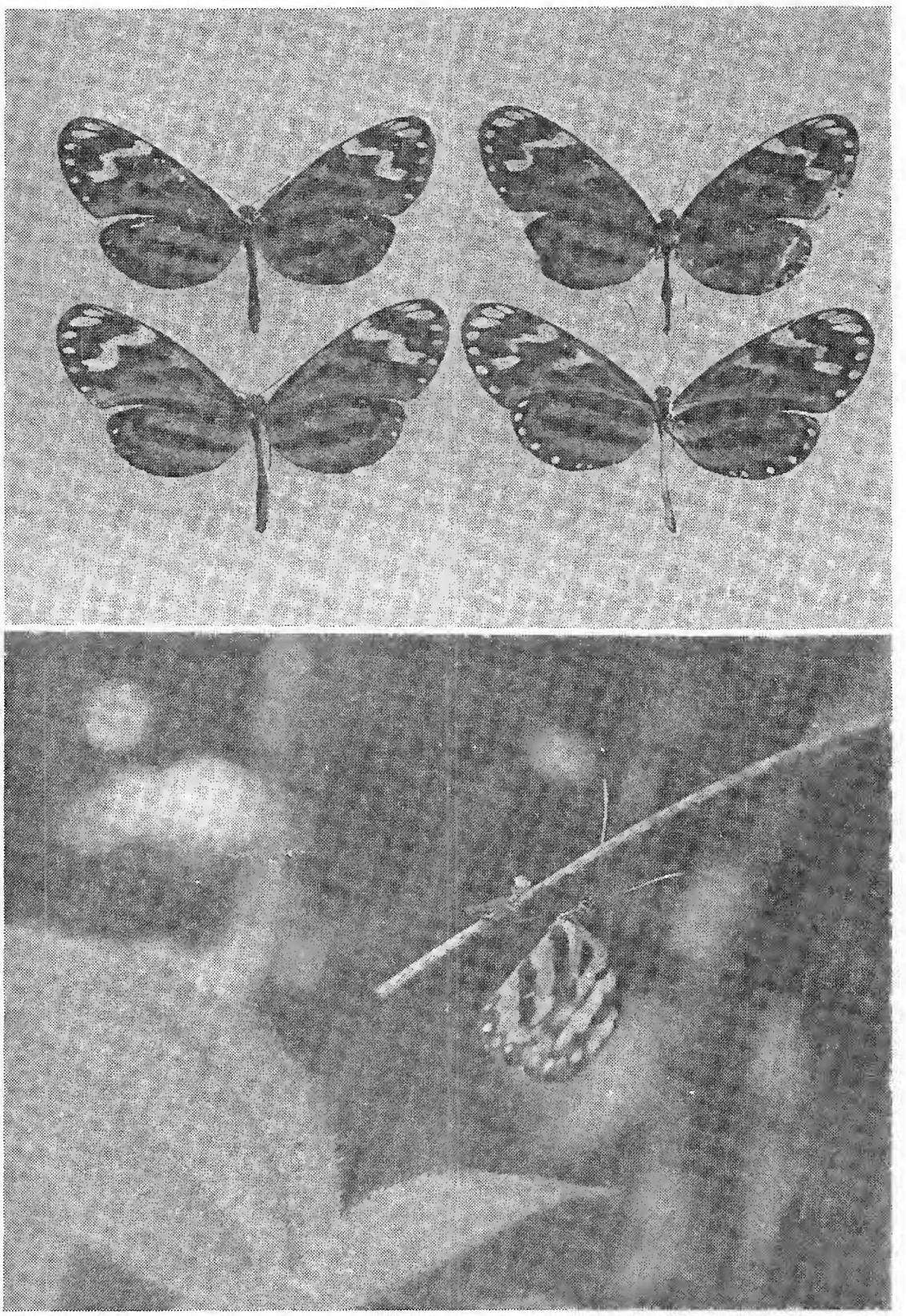

Fig. 3. Top: a series of laboratory-reared *H. euclea* (left column — 2 females; right column — male above, female below). Bottom: *Hypothyris euclea* feeding on the leg of a grasshopper in forest understory, Finca La Tirimbina, Costa Rica, February 1976.

havioral trait. In fact, an interesting comparison of the early stages can be made between *Hypothyris* as a representative of the Napeogenini and *Mechanitis* as a representative of the Mechanitini.

Fig. 4. Heavy defoliation of mature leaves of *Solanum rugosum* by second instar caterpillars of *H. euclea* at Finca La Tirimbina (January 1976).

Fox (1967) has reported the early stages and gregarious larvae of *Mechanitis.* Several differences are noted: (1) the larvae of *Hypothyris* lack the lateral tubercles and uniform coloration of *Mechanitis* larvae, (2) egg size and size of egg rafts are larger in *Hypothyris* than *Mechanitis,* (3) the pupa of *Hypothyris* is short and thick in profile, while that of *Mechanitis* is elongate and thin, and (4) groups of gregarious larvae are considerably larger in *Hypothyris* than in *Mechanitis.* Furthermore, *Mechanitis* lays eggs on the small, heavily-spined species of *Solanum* (Fox, 1967), differing from *S. rugosum,* in terms of size, profile, leaf texture, and lack of spines (in *S. rugosum).* Examinations of about 100 plants of *Solanum* spp. attacked by *Mechanitis isthmia* at Finca La Tirimbina during February 1976 (A.M. Young, pers. obs.) revealed that in no instances were individual plants (usually widely scattered) heavily defoliated, and mortality of egg rafts was very high. These biological traits are different from the interaction of *H. euclea* with *S. rugosum* at the same locality. It shares with *Mechanitis* the characteristic of being very abundant locally, unlike most other ithomiines. In addition to biological traits such as cluster oviposition, gregariousness of larvae, and an abundant food

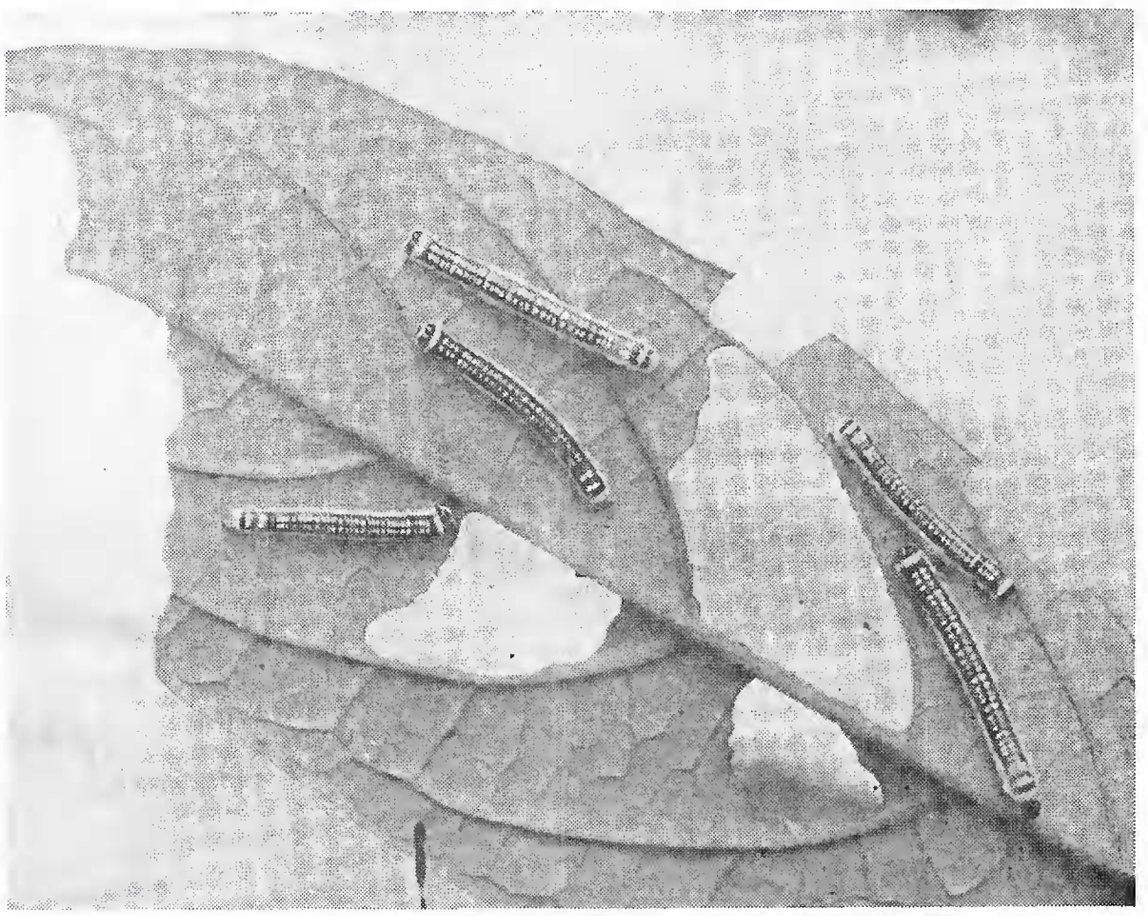

Fig. 5. Defoliation by fourth instar caterpillars of *H. euclea*.

plant, *Hypothyris* may be experiencing local population expansions, perhaps similar to that noted for *Mechanitis* in Brazil (Brown and D'Almeida, 1970).

The gregarious behavior of the larvae, and the bright coloration of caterpillars and adults, suggest unpalatable properties in this butterfly. The "tiger-stripe" ithomiines are classical unpalatable models for mimicry complexes (Bates, 1862; Müller, 1878; Brown and Neto, 1976), including some species of *Hypothyris*.

Perhaps, in addition to intensifying the advertisement of distasteful properties to vertebrate predators, cluster oviposition and the gregarious behavior of larvae have important consequences for the food plant. Barcant (1970) reports that *H. euclea* adults are abundant at certain localities in Trinidad at the wet season's onset, but that numbers dwindle subsequently. Birch (1957) argues that local climatic factors play major roles in determining the abundance of some insects. A period of prolonged and intense rainfall in the tropics promotes the growth of leaves, while the dry season promotes the flowering and fruiting of some tree species (Janzen, 1967). Thus, by the end of the wet season, the local plant community is characterized by a large leaf biomass, providing a reliable and

abundant food base for some herbivorous insects. Given other suitable environmental conditions, populations of herbivorous insects might become high by the end of the wet season and early dry season in seasonal tropical habitats. The Premontane Wet Forest life zone in Costa Rica is characterized by alternating bouts of dryness and wetness, but the longest succession of wet days occurs between October and December, and the longest period of dry days occurs in March. Thus, by early January, many plants may have allocated most of their energy to vegetative growth. For *H. euclea* on *S. rugosum*, a wet period resulting in a large potential food base for larvae followed by several short series of dry days that optimize courtship and oviposition promotes rapid growth of the adult population. The last two weeks of December (1975) were exceptionally dry (Dr. Robert Hunter, personal communication), and these conditions promoted reproductive activity in *H. euclea* and other butterflies. But, during January and February, although there are many days of complete dryness, there are 3–5 day wet periods that promote mass larval mortality and reduced oviposition. Some studies have shown that adult butterflies may even be killed by bursts of intense rainfall (e.g., Cook et al., 1971). Although adults of *H. euclea* appear to be slow fliers, it seems likely that, if necessary, breeding should extend to all clumps of *S. rugosum* if the population is resource-limited at this time of the year. However, this does not happen and some clumps escape from heavy defoliation. Those clumps that are intensely fed upon show a reduction in fruit set. *Solanum rugosum* flowers and sets fruit during the short, erratic dry season, as do trees in more seasonal regions of Costa Rica (Janzen, 1967; Frankie et al., 1974). Prior to, and during this period there is intense reproductive activity by the butterfly. The progressive reduction of host leaf biomass due to larval feeding during January

Table 1. Patterns of heavy leaf attack by caterpillars of *Hypothyris euclea* and flowering and fruiting in four patches* of *Solanum rugosum* in premontane tropical wet forest near La Virgen, Heredia Province, Costa Rica, February 12, 1976.

Patch No.	No. trees with flowers/fruits and attacked	No. trees with flowers/fruit and not attacked	No. trees with no flowers/fruit and attacked	No. trees with no flowers/fruit and not attacked
1	0	21	0	7
2	1	3	15	0
3	0	2	4	4
4	0	16	0	5

*The four patches are widely separated along a dirt road that connects Finca La Tirimbina to the Penal Colony at Magasay. Only trees 2-3 meters tall were included in the census, although there were trees less than 2 meters tall that experienced heavy defoliation: Patch No. 1-0, Patch No. 2-8, Patch No. 3-0, Patch No. 4-4. Patches were of similar size, each occupying about 5-6 meters of roadside secondary forest.

Fig. 6. Defoliated bushes of *S. rugosum*.

and February, the specificity to a single host plant, the shift in allocation of energy to flowers and fruit, and the mortality of larvae are factors promoting a reduced breeding population of *H. euclea* by late March.

Acknowledgments

This study is a by-product of National Science Foundation Grant GB-33060, and a travel grant from the Milwaukee Public Museum. The assistance of Dr. Kenneth Starr of the Milwaukee Public Museum is appreciated. I thank Dr. Lee D. Miller (Allyn Museum of Entomology) for identifying the butterfly, and Sr. Luis Poveda (Museo Nacional de Costa Rica) for identifying the host plant. The cooperation of Dr. J. Robert Hunter for logistical support and facilities at Finca La Tirimbina is appreciated. I thank Cheryl Castelli for typing the manuscript.

Literature Cited

Barcant, M. 1970. Butterflies of Trinidad and Tobago. London: Collins Press.

Bates, H. W. 1862. Contributions to an insect fauna of the Amazon Valley, Lepidoptera: Heliconidae. Trans. Linn. Sci. London 23:495-566.

Birch, L. C. 1957. The role of weather in determining the distribution and abundance of animals. Cold Spring Harbor Symp. Quant. Biol., 22:203-218.

Brown, K. S., Jr. 1972. Maximizing daily butterfly counts. J. Lepid. Soc. 26:183-195.

Brown, K.A., Jr., and R.F. D'Almeida. 1970. The Ithomiinae of Brazil (Lepidoptera: Nymphalidae). II. A new genus and species of Ithomiinae with comments on the tribe Dircennini D'Almeida. Trans. Amer. Ent. Soc. 96:1-17.

Brown, K. S., Jr., and J. V. Neto. 1976. Predation on aposematic ithomiine butterflies by tanagers *(Pipraeidea melanonota).* Biotropica 8:136-141.

Cook, L. M., K. Frank, and L. P. Brower. 1971. Experiments on the demography of tropical butterflies. 1. Survival rates and density in two species of *Parides.* Biotropica 3:17-20.

Fox, R. M. 1967. A monograph of the Ithomiidae (Lepidoptera), Part III, the tribe Mechanitini Fox. Mem. Amer. Ent. Soc., No. 22, 190 pp.

Frankie, G. W., H. G. Baker, and P. A. Opler. 1974. Comparative phenological studies of trees in tropical lowland wet and dry forest sites in Costa Rica. J. Ecol. 62:881-929.

Holdridge, L. R. 1967. Life zone ecology. Tropical Sci. Center, San Jose, Costa Rica.

Janzen, D. H. 1967. Synchronization of sexual reproduction of trees within the dry season in Central America. Evolution 21:620-637.

Müller, F. 1878. Uber die Vortheile der Mimicry bei Schmetterlinge. Zool. Orz. 1:54-55.

Rathcke, B. J. and R. W. Poole. 1975. Coevolutionary race continues: butterfly larval adaptation to plant trichomes. Science 187:175-176.

Young, A. M. 1974. A natural historical account of *Oleria zelica pagasa* (Lepidoptera: Nymphalidae: Ithomiinae) in a Costa Rican mountain rain forest. Studies Neotrop. Fauna 9:123-140.

SCIENTIFIC NOTE

Biological and Distributional Data for *Evergestis angustalis* (Lepidoptera: Pyralidae) *Evergestis angustalis* (Barnes & McDunnough) is a primarily desert species which flies in winter and early spring and is easily recognized by its exceptionally narrow forewings. The typical subspecies is known from the western Colorado Desert area of southern California. Munroe (1973, The Moths of America North of Mexico. Fasc. 13.1C Pyraloidea, Pyralidae (part). Evergestiinae. pp. 253-304.) indicated that he had seen specimens only from three localities in western Imperial and eastern San Diego counties in the low desert, but, in contradiction, stated that *angustalis* also occurs in the Mojave-Desert. He also characterized new subspecies from central Arizona and Santa Catalina Island, California. Records in the Essig Museum of Entomology, University of California, Berkeley, provide life history data and show that the species is considerably more widespread, occurring in Baja California Norte and northward into central California.

The flight occurs in January and February in southern California and in Arizona, but there is one record each for May and July in Arizona (Munroe, 1973). Adults have been taken at lights elsewhere during early spring: in Baja California Norte, near Santo Domingo and 5 miles east of El Rosario, Mar. 18, 19, 1972 (Doyen & Powell); and in the San Francisco Bay area of California, at Alum Rock Park (near San Jose), Santa Clara Co., Mar. 8, 1960 (S. D. Smith) and at Walnut Creek, Contra Costa Co., Feb. 9, 1972 (J. Powell).

Larvae were found feeding in hollow stems of *Caulanthus inflatus* Wats. (Cruciferae) at Big Panoche Gorge, San Benito–Fresno Co. line, April 21, 1967, and one moth emerged Jan. 23, 1968 (J. Powell no. 67D88). This plant is a desert species which reaches its northern limit in western Fresno County and its southern limit in the Mojave Desert (Munz, 1963, California Flora. U. Calif. Press, Berkeley; 1681 pp). All other collection records are outside the known range of *Caulanthus inflatus* and presumably represent populations of *E. angustalis* associated with other Cruciferae. — J. A. POWELL, *University of California, Berkeley 94720.*